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GARBAGE HEAT TREATMENT IN MASSACHUSETTS

Paul E. James and Harry J. Eby, Jr.
Agricultural Research Service, USDA, in cooperation
with the University of Massachusetts

The practice of cooking garbage before feeding to swine in order to control VE and other swine diseases has become widespread in the last 3 years. The increasing use of the practice increases the need for more knowledge about equipment and methods of cooking.

The swine raisers in Massachusetts are now cooking their garbage, thus killing any disease virus in it such as Vesicular Exanthema which might infect their herds. In order to do this they set up various types of cooking equipment as described by the University of Massachusetts and the U. S. Department of Agriculture. Upon using this equipment for a while the feeders began to inquire about the efficiency of the various types of equipment.

The equipment was all comparatively new and results were not available which could give the feeders a satisfactory answer. It was therefore decided to conduct research in heat-treating costs. In addition to the garbage feeders, the municipalities also needed more information on the additional heat-treating costs in order to arrive at fair and equitable garbage removal contracts. This research will help the garbage feeder determine if his heat-treating method is costing more than it should by comparing it with the costs of other methods.

Types of Equipment

Most of the equipment studied was one of the following three types:

Direct Fire Equipment (factory made)

This equipment is of two types. (1) In one type the vat containing the garbage is enclosed in an outer jacket spaced about an inch from the actual cooking vat. A burner located at the bottom of the vat throws heat between the inner and outer shells. (2) In the other type the flames are passed through a "U" shaped heating pipe set in the bottom of the vat. Water is added at least to cover the heating pipes and a grill placed just over the pipes keeps the solid portion of the garbage out of direct contact with the heating pipes, thus preventing scorching of the garbage.



Steam Cleaner and Steam Injector Pipes in Vat

This type of equipment consists of a vat having pipes in the bottom. Holes in these pipes allow the steam to escape in the garbage. Steam is supplied by a steam cleaner. The steam cleaners were designed for cleaning dirt and grease from automobile engines. They consist of a continuous coil of pipe placed in a firebox. Cold water is fed in the bottom and hot water with some steam is ejected at the outlet end. This steam and water mixture is not well suited for garbage heating by injection as the hot water from the cleaner accumulates in the load while the steam does most of the heating.

Boiler and Injector Pipes in Vat

This type of equipment consists of a vat containing steam injector pipes in the bottom connected to a steam boiler. New steam boilers produce steam containing very few droplets of water in it. It is well suited for injection directly in the load as little hot water from the boiler accumulates in the load while the steam does the heating. Figures 1 and 2.

Method

It was decided to study each piece of equipment on the premise where it operates. As a result, an itinerary was set up which would allow a visit to be made to each premise tested. Since it was not practical to visit all of the feeders in the state it was decided to visit representative samples. Due to the wide diversity of equipment a cross-section of the major types was taken. The types sampled for cost and analysis were:

1. Direct fire type (oil burners only)
2. Steam cleaners and injector pipes
3. Steam boilers under 50 h.p. and injector pipes
4. Steam boilers over 50 h.p. and injector pipes

No attempt was made to get cost figures on operations using wood, coal, or old tires as fuel. Various types of garbage were tested since some types require a longer heating time because of poor heat penetration. Cost analyses were run with the following types of garbage: household, restaurant, institutional, military and a general category of "other" which includes poultry offals, slaughter house waste and packing plant waste.

Other incidental costs such as additional taxes and insurance were omitted because they were either too small to effect the overall cost or were unknown by the operator. In this study the labor cost involved in cooking was omitted.



Figure 1. Truck shelter with boiler house attached

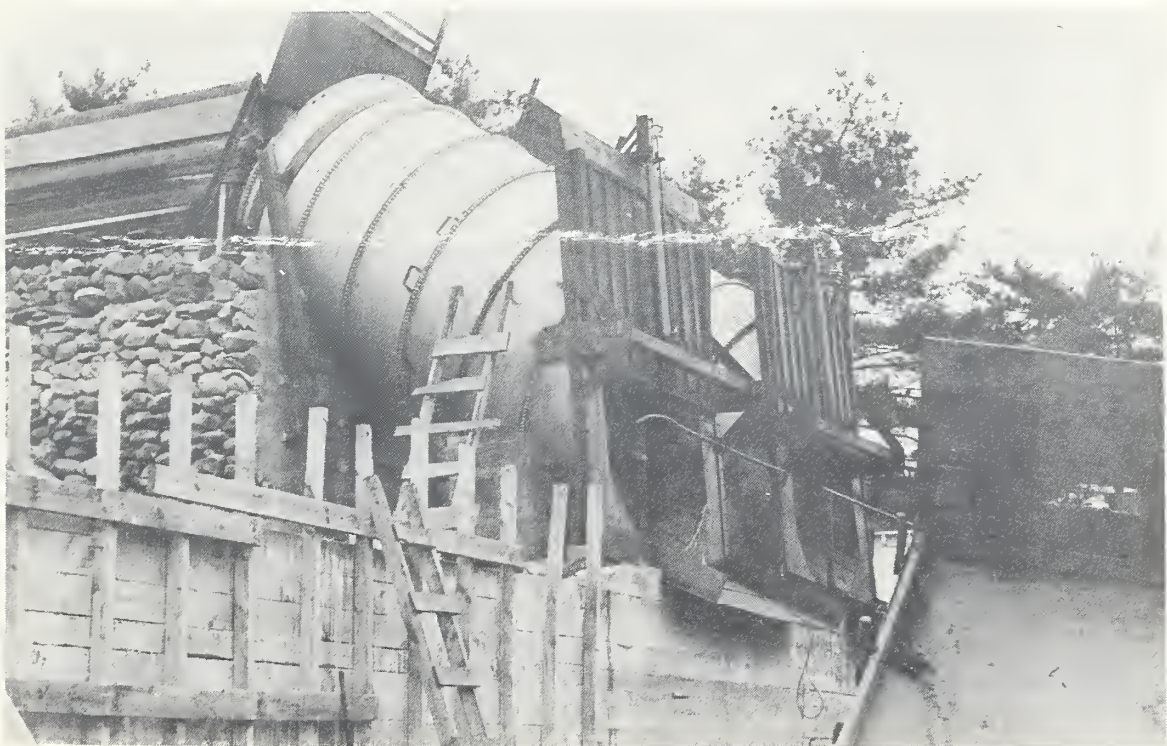


Figure 2. Large cooking vats with hydraulic lift gates

Results

The results of the study are shown in the table Cost Analysis of Garbage Cooking in Massachusetts, May, 1955.

The garbage depth tabulated is at the completion of cooking. The quantity of garbage cooked per year is based on the estimated average daily volume. Costs were put on a per cubic yard basis due to the considerable variation in the consistency of the garbage cooked. In most cases, however, water in varying amounts was added to the garbage--in general, the more paper and trash, the more water so that the end product weighed about the same. The cost of electricity to operate cooking equipment was in all cases too low to have any appreciable effect on cost per cubic yard.

Costs of equipment and installation varied widely because some feeders had necessary materials such as pipe on the farm which could be used instead of purchasing new pipe. Another reason for the price difference in installation was in labor costs. Some feeders were able to assemble their equipment while others paid for this labor.

The life of cooking equipment varies considerably. Just as with an automobile, a careful operator who keeps his equipment in good repair may keep it operating many times as long as a careless operator can operate the same equipment. From the fragmentary observations made by the feeders, the average life of their equipment is estimated as follows:

Direct fire equipment	5 years
Steam cleaners & vats	5 years
Boilers & vats	15 years

Observations and Recommendations

Although cooking temperatures were measured as part of this research, normally none of the feeders measured temperatures during cooking. Since loads in any one feeding operation vary in size and type, it is recommended the cooking time of the largest and most difficult one be measured and established as the cooking time. However, this time may have to be increased in colder weather. The feeder can most efficiently determine that each load is heated to the required temperature by beginning to measure temperatures when he thinks the load is about finished. These readings would indicate when to cut off the heat.

It is recommended for efficient operation that the load be stirred. Stirring reduces the size of the cold regions and places the cold garbage in contact with the hot.

Undersize boilers and steam cleaners were inefficient because they required a longer heating period with the consequent longer periods of heat loss from the sides of the vat or truck. For efficient operation it is recommended that the boiler have a capacity of eight horsepower for each ton, approximately four-fifths cubic yard of garbage.

Many steam cleaner operators were not familiar with their equipment. Sometimes they let it freeze. To reduce maintenance costs it is recommended that the operators become thoroughly familiar with the construction of their equipment and requirements for its efficient operation. They should know the necessary precautions to protect it in cold weather.

Those installations having good, tight lids were most efficient. It is recommended that a tightly sealed lid be used.

Conclusions

A summary of the average cost figures is as follows:

	<u>Total cooking cost</u>		<u>Cost of</u>	
	<u>Per cu. yard</u>	<u>Per drum:</u>	<u>Equipment</u>	
	Apx.1600 lbs.	55gals.:		
Direct fire equipment	\$1.12	:	.37	\$1,342.00
Steam cleaner & vat	1.37	:	.46	2,317.00
Small boiler & vat	1.05	:	.35	5,300.00
Large boiler & vat	.92	:	.31	20,000.00

Using factory made direct fire equipment, it cost about \$.37 to cook a 55 gallon drum of garbage.

Using a steam cleaner and piped vat, it cost about \$.46 to cook a 55 gallon drum of garbage.

Using boilers and piped vats or trucks it cost about 31 to 36 cents to cook a drum or about \$1.00 to cook a cubic yard of garbage, see table above.

The cost of equipment and repairs was a large part of the cooking costs. This varied from 48 cents of each dollar spent for cooking with a steam cleaner to 28 cents of each dollar spent using boilers and piped vats or trucks.

COST ANALYSIS OF

COOKING TANK OR TRUCK							FUEL						
	Width	Leng.	Dep.	Lid ¹	Pipes No.	Spac.	Oil Gr.	Oil Am't.	Oil Cost	KWH Cost	KWH Used	Tot KWH Cost	Cost Oil & Elec.
							Gal						
Direct	-	-	18"	G	-	-	#1	10	.15	-	-	-	\$1.50
Fire	-	-	18"	G	-	-	#1	10	.15	-	-	-	1.50
	-	-	18"	G	-	-	#1	9	.135	-	-	-	1.22
Steam Generator	71"	96"	18"	G	6	14"	#1	12.4	.15	.035	3.7	.13	1.99
	84"	144"	12"	P	3	18"	#1	15	.16	.035	4.5	.157	2.56
	60"	120"	18"	P	6	12"	#1	12.2	.15	.06	-	-	1.89
	60"	102"	18"	P	6	12"	#1	9	.15	.06	-	-	1.41
	66"	102"	18"	P	6	12"	#1	10.1	.145	.06	-	-	1.51
	48"	72"	12"	P	14	4'7"	#2	5	.15	.06	-	-	.81
Boilers	72"	140"	15"	P	6	12"	#2	13.5	.14	.12	-	-	2.00
	48"	116"	37"	P	7	10"	#2	21.	.14	.15	-	-	3.08
	78"	144"	12"	P	7	12"	#2	8.	.14	.035	1.	.035	1.16
	78"	144"	12"	G	8	10"	#2	21.	.14	.035	1.	.035	2.96
	84"	144"	24"	G	7	12"	#2	29.3	.14	.035	1.5	.05	4.15
	84"	144"	12"	G	7	12"	#2	15.75	.136	.035	1.	.035	2.18
	90"	94"	12"	P	7	12"	#2	18.	.148	.035	1.5	.05	2.71
	84"	144"	15"	G	7	12"	#2	18.	.136	.035	1.	.035	2.48
	65"	116"	37"	G	7	10"	#2	32.	.15	.035	2.	.07	4.57
	90"	144"	12"	G	7	11"	#2	21.	.15	.035	2.	.07	3.22
Boilers (over 50 h.p.)	84"	150"	24"	G	7	12"	#5	33.	.09	.035	4.9	.17	3.14
	-	-	24"	G	-	-	#5	43.4	.08	.035	8.4	.30	3.62
	86"	174"	24"	G	-	-	#5	38.5	.08	.035	6.	.21	3.31
	88"	192"	30"	P	9	10"	#5	43.75	.095	.035	6.	.21	4.39

1 Lid: G-Good
P-Poor

GARBAGE COOKING IN MASSACHUSETTS

May-1955

BOILER		GARBAGE			C O S T					
H.P.	Opr. Pres.	Type ²	Cu Yds.	Loads pr.wk.	Equip-ment	Deprec. per yr.	Cu.yds. per yr.	Deprec. per cu.yd.	Fuel cost/cu.yd.	Tot. cost/cu.yd.
-	-	H	1.6	6	\$1500.	\$300.	500.	\$.60	\$.94	\$1.54
-	-	H-O	2.46	7	900.	180.	895.	.20	.61	.81
-	-	H-R	2.22	6	1625.	325.	692.	.47	.55	1.02
							Average:	.42	.70	1.12
-	75	H-R	2.6	2	1900.	380.	272.	.71	.77	1.48
-	75	H-R	3.1	6	5000.	1000.	965.	1.04	.83	1.87
-	75	H-R	2.8	6	2100.	420.	873.	.48	.68	1.16
-	65	R	2.3	6	1900.	380.	718.	.53	.61	1.14
-	75	R	2.6	6	1900.	380.	812.	.47	.58	1.05
-	-	O	1.0	6	1100.	220.	312.	.70	.81	1.51
							Average:	.66	.71	1.37
30	65	H	2.7	12	3400.	226.	1685.	.13	.74	.87
30	70-80	H	4.42	6	3400.	226.	1380.	.16	.70	.86
50	15-20	H-R	1.75	7	3300.	220.	637.	.34	.66	1.00
30	60-70	H-R	2.9	6	3400.	226.	900.	.25	1.02	1.27
30	60-80	H	6.2	6	4000.	266.	1940.	.14	.67	.81
30	60-70	H-R-I	3.1	6	8900.	593.	965.	.61	.70	1.31
20	60	H	3.	5	5290.	353.	780.	.45	.90	1.35
30	60-70	H-R	3.4	6	8900.	593.	1060.	.56	.72	1.28
30	60	H	5.9	6	3400.	226.	1840.	.12	.77	.89
30	80	H	4.6	6	3400.	226.	1430.	.16	.70	.86
							Average:	.29	.76	1.05
85	30-40	H	6.7	5	10000.	666.	1740.	.39	.47	.86
100	90	H	7.0	22	35000.	2333.	8000.	.29	.52	.81
75	80	H-R	5.5	60-65T	16000.	1066.	1790.	.51	.60	1.11
103	40	H	7.75	100T	20000.	1333.	4030.	.33	.56	.89
							Average:	.38	.54	.92

2 Type of garbage:

H-Household

R-Restaurant

I-Institutional

O-Other

